1 505 702

PATENT SPECIFICATION (11) 1 505 702

(21) Application No. 31216/75 (22) Filed 25 July 1975
(44) Complete Specification published 30 March 1978
(51) INT CL² A47C 3/30; F16F 9/02
(52) Index at acceptance F2S 201 8M1C 8M4G 901 BG
(72) Inventors LUDWIG STADELMANN and FRITZ BAUER

(19)

(54) LENGTHWISE-ADJUSTABLE GAS SPRING

(71) We, SUSPA FEDERUNGSTECHNIK FRITZ BAUER & SOHNE oHG, of 12—14, Industriestrasse, 8503 Altdorf b. Nurnberg, Federal Republic of Germany, an Offenes Handels Gesellschaft organised under the laws of the Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to lengthwise-adjustable compressed-gas-filled gas springs. British Patent Specification No. 1,237,989 discloses a lengthwise-adjustable, compressed-gas-filled gas spring, particularly for continuous height adjustment of chairs seat, or tables, which comprises two cylinders mounted coaxially one inside the other, and with a piston displaceably mounted in the inner cylinder, said piston being provided with a seal resting against the inside wall of the inner cylinder which divides the inner cylinder into two chambers. The piston is connected to a piston rod, which emerges from one end of the outer cylinder in a sealed manner. The chamber on the piston rod side is always in communication at least one opening with the annular chamber between the cylinders. A valve serves to control the communication between the other chamber and the annular space via at least one passageway. A valve pin for controlling the valve is provided in the sealing plug of the outer cylinder and the inner cylinder at the end opposite the piston-rod end. The valve pin is capable of being pushed into the gas spring to open the communication between said other chamber and the annular chamber.

The sealing plug is provided with a bore with a slightly larger diameter than a cylindrical part of the valve pin, the bore having a stepped partition which contains a seal sealingly engageable with said cylindrical part of the pin. A by-pass chamber is provided, said chamber being connected on one side via a bore in the inside part of the cylindrical annular chamber and on the other side with the bore in the sealing plug via a connecting passageway which if formed, when the valve pin is pushed in, between an annular groove in the latter and the inside wall of the seal. In this known lengthwise-adjustable gas spring a special valve is therefore provided at one end.

This lengthwise-adjustable gas spring has proven excellent in practice.

The goal of the present invention is to simplify a lengthwise-adjustable gas spring with regard to its construction and assembly costs and simultaneously to increase its dependability.

According to the present invention there is provided a lengthwise-adjustable, compressed-gas-filled gas spring comprising an outer cylinder; an inner cylinder coaxially disposed in said outer cylinder, defining an annular chamber therebetween; a piston axially displaceable mounted within said inner cylinder, said piston sealingly dividing the inside of said inner cylinder into first and a second chambers, a piston rod connected at one end to said piston on the side facing said first chamber, said piston rod extending out of said cylinders in a sealed manner; fluid connection between said first chamber and the annular chamber; wherein said inner cylinder is axially displaceable within said outer cylinder, sealing means being disposed between the end of the inner cylinder opposite that from which said piston rod extends and the annular cylinder the inner cylinder having a passageway there through in the vicinity of said sealing means the sealing means sealing off said passageway in one axial position of said inner cylinder within said outer cylinder and permitting access from said second chamber to said annular chamber through said passageway when said inner cylinder is in a second axial position within said outer cylinder.

The essence of the present invention therefore consists in the inner cylinder serving simultaneously as a valve and as an

actuating device therefore, with no significant additional expense being required for construction of the inner cylinder. A better seal with respect to the outside is provided by giving the inner cylinder a larger diameter than the operating pin of a valve. In addition, the gas chamber is enlarged, without increasing the structural length and outside diameter of the gas spring, since the inner cylinder extends at least up to the end face of the gas spring opposite the piston-rod end, so that the damping characteristics of the spring can be improved for a given length.

A preferred embodiment of the present invention makes it possible to guide the inner cylinder at the end of the outer cylinder opposite the piston-rod end in a simple sleeve. Advantageously, it is provided with a stop which prevents its being expelled from the outer cylinder, and said stop may be given the form of a stop ring which rests against the inside end face of the sleeve, wherein such a stop ring can be formed simply by rolling out the inner cylinder. It has been found advantageous to locate the passageway in the vicinity of an annular chamber formed by a constriction of the wall of the inner cylinder, said channel bridging a seal in the sleeve when the inner cylinder is slid into the gas spring.

In order to suppress any tilting of the inner cylinder and the piston rod and consequently to eliminate the danger of leakage of the gas spring, it is advantageous to guide the inner cylinder in a manner which is practically free of radial play at the piston-rod end, wherein this guidance can be effected by guiding the inner cylinder radially on a tubular member on a sealing sleeve which seals off the outer cylinder in a gas tight manner and seals the piston rod as it emerges from the outer cylinder.

The blockable passageway in the wall of the inner cylinder can be constructed in a simple manner as a flow throttle by appropriate dimensioning.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is an axial lengthwise section through a gas spring according to the present invention with an inner cylinder serving as an actuating valve with the valve in the closed position, and

Figure 2 shows the gas spring in the design shown in Figure 1 with the valve in the operated position.

The gas spring is provided with a housing 1, consisting primarily of two concentrically mounted steel tubes of different diameters sliding into one another, i.e. an inner cylinder 2 and an outer cylinder 3. A piston 5 is axially displaceably mounted in inner cylinder 2, with an annular seal 4 on its outside circumference, said piston bearing via said seal against the inside wall of inner cylinder 2. The piston 5 is further attached to one end 6 of a piston rod 7 which is mounted coaxially in the housing and emerges therefrom. The piston rod is guided in a manner practically free of radial play in a sealing sleeve 8, said sealing sleeve being press-fitted in outer cylinder 3 and having an annular seal 9 on its outside circumference. This sealing sleeve 8 is prevented from being forced out of outer cylinder 3 by means of a bead 10 on outer cylinder 3 which fits over its outwardly facing end face.

A lip seal 12 is located in a cylindrical recess 11 in the sealing sleeve 8, the sealing lips of said lip seal resting against piston rod 7, so that the latter can also be led out from housing 1 in a sealed manner. Lip seal 12 is protected against axial displacement with respect to sealing sleeve 8 by means of a retaining disc 13 mounted between sealing sleeve 8 and bead 10. Inner cylinder 2 has its end 2′ on the piston-rod side resting against a tubular stop 14 extending coaxially with inner cylinder 2 from the sleeve 8, said stop 14 being mounted on sealing sleeve 8 in such a mannner that inner cylinder 2 is practically free of radial play but is supported in an axially displaceable manner.

Piston 5 divides the inside chamber of inner cylinder 2 into two chambers, namely a chamber 15 which faces the end of housing 1 from which the piston rod emerges, and a chamber 16 which is located on the other side of piston 5. Chamber 15 on the piston-rod side is always connected by a bore 17 in stop 14 with annular space 18 formed between inner cylinder 2 and outer cylinder 3. Tubular stop 14, at least from said bore 17 to its free end, has a larger inside diameter than the diameter of piston rod 7.

Inner cylinder 2 is sealed in a gastight manner at its end face by a plate 19 at the end of housing 1 which is opposite the end from which the piston rod emerges. It is led out of housing 1 at this end by a cylindrical annular sleeve 20. Sleeve 20, like sealing sleeve 8, is press-fitted in outer cylinder 3 and seals off said outer cylinder in a gastight manner by an annular seal 21. It is prevented from sliding out of housing 1 by a bead 22 which fits over its outwardly facing end face.

The inner cylinder is prevented from sliding out of housing 1 by means of a stop ring 23 located in annular space 18 and made for the example by rolling out or swaging the material of the cylinder. Said stop ring has a larger diameter than the coaxial cylindrical bore 24 which guides the inner cylinder in sleeve 20. In the position shown in Figure 1, wherein stop ring 23 rests against the inward-facing end face of sleeve

20, the inner cylinder projects from housing 1. Annular seals 27, 28 are provided in corresponding annular grooves 25, 26 in bore 24 of sleeve 20, separated by a distance such that each seals off inner cylinder 2 in a gastight manner with respect to sleeve 20. A constriction which serves as an annular channel 29 is provided on inner cylinder 2, said constriction (in the position of inner cylinder 2 shown in Figure 1) being located between the two annular seals 27 and 28. The distance between these two annular seals 27 and 28 is therefore always greater than the axial length of this annular channel 29. The wall of inner cylinder 2 in the vicinity of annular channel 29 is provided with at least one passageway 30 shaped like a throttle bore, said passageway connecting annular channel 29 with chamber 16.

The gas spring described and shown above is filled with compressed gas, advantageously with nitrogen, i.e. chambers 15, 16 and annular chamber 18 are under gas pressure. The gas spring operates as follows:—

With inner cylinder 2 in the position shown in Figure 1, passageway 30 is located between the two annular seals 27, 28 so that there is no connection between chamber 16 and annular chamber 18, while a connection between chamber 15 on the piston-rod side and annular chamber 18 is always provided by bore 17. Piston 5 and hence piston rod 7 are therefore in a predetermined, balanced, operating position as shown for example in Figure 1. If a force is now exerted from outside on piston rod 7, it is cushioned by the gas filling in chamber 16 or the gas filling in chamber 15 and in annular chamber 18.

If inner cylinder 2, by the exertion of a corresponding actuating force 31 upon the plate 19, is pushed sufficiently far into housing 1 that annular channel 29 bridges the inside annular seal 28 of sleeve 20, as shown in Figure 2, gas can flow from chamber 15 through bore 17, via annular chamber 18, annular channel 29, and passageway 30 into chamber 16 on the other side of piston 5. Since the area of piston 5 subject to gas pressure on the side facing chamber 16 is larger by the cross-section of piston rod 7 than its area which faces chamber 15, piston 5 and hence piston rod 7, in the absence of a corresponding counterforce acting upon piston rod 7 from outside, is pushed out of housing 1. On the other hand, if an inward-pushing force 32 is exerted on piston rod 7, said force being greater than the product of the gas pressure and the cross-section of piston rod 7, the latter is pushed into housing 1. If actuating force 31 is removed from plate 19 of inner cylinder 2 with piston rod 7 in the desired set position and hence piston 5 in the same position, the inner cylinder will slide back to the position shown in Figure 1 so that the connection between chamber 16 and annular chamber 18 is once again broken. Piston 5 and hence piston rod 7 then remain in the newly set position relative to housing 1. Of course, inner cylinder 2 can be pushed only so far into housing 1 that it does not close off bore 17 in the pushed-in position. The ratio of the piston rod diameter to the inside diameter of outer cylinder 3 is advantageously less than 0.5, so that the gas spring has a nearly horizontal path-force curve, i.e. the forces required to bring piston rod 7 to its completely extended and completely inward-pushed positions will differ only slightly.

Piston rod 7 is provided at its free end with a pin 33, said pin having a somewhat smaller diameter than piston rod 7 and having an annular groove 34 in the vicinity of its free end. It is thus possible to attach the piston rod to an object, for example, a chair frame, as described in German Auslegeschrift 1,931,012.

Of course, the gas pressure is made sufficiently high that the expulsion force required to lift a supported object (table top, chair seat, or the like), said force being constituted by the product of the gas pressure and the free piston ring surface, is achieved at every position of the piston in the housing.

Sealing plug 8 and sleeve 20, if it proves necessary, may be further protected against displacement in housing 1 by means of beads fitting over their inwardly-located end faces in outside cylinder 3.

WHAT WE CLAIM IS:—

1. A lengthwise-adjustable, compressed-gas-filled gas spring comprising an outer cylinder; an inner cylinder coaxially disposed in said outer cylinder, defining an annular chamber therebetween; a piston axially displaceable mounted within said inner cylinder, said piston sealingly dividing the inside of said inner cylinder into first and a second chambers, a piston rod connected at one end of said piston on the side facing said first chamber, said piston rod extending out of said cylinders in a sealed manner a fluid connection between said first chamber and the annular chamber; wherein said inner cylinder is axially displaceable within said outer cylinder, sealing means being disposed between the end of the inner cylinder opposite that from which said piston rod extends and the annular cylinder the inner cylinder having a passageway there through in the vicinity of said sealing means the sealing means sealing off said passageway in one axial position of said inner cylinder within said outer cylinder and permitting access from said second chamber to said annular chamber through said

passageway when said inner cylinder is in a second axial position with said outer cylinder.

2. A gas spring in accordance with claim 1 wherein the sealing means includes sleeve means for guiding said inner cylinder within said outer cylinder at the end thereof opposite that from which the piston rod extends.

3. A gas spring in accordance with claim 1 or 2 further including stop means for preventing said inner cylinder from sliding out of said outer cylinder.

4. A gas spring in accordance with claim 2 or 3 when dependent thereon further including a stop ring on said inner cylinder which abuts on said sleeve means when said inner cylinder is axially displaced to the position at which said sealing means seals off said passageway.

5. A gas spring in accordance with any one of claims 1 to 4, wherein the wall of said inner cylinder in the vicinity of said passageway is constricted to form an annular channel.

6. A gas spring in accordance with any one of claims 1 to 5 further including guide means for guiding said inner cylinder, at the piston rod end thereof, in a manner which is substantially free of radial play.

7. A gas spring in accordance with claim 6 further including sealing sleeve means for closing said outerside cylinder around said piston rod in a fluid-tight manner, and a tubular stop on said sealing sleeve means radially guiding said inner cylinder.

8. A gas spring in accordance with any one of claims 1 to 7, wherein said passageway is made in the form of a flow throttle.

9. A lengthwise-adjustable, compressed-gas-filled gas spring substantially as described herein, with reference to, and as illustrated in, the accompanying drawings.

JENSEN & SON,
Agents for the Applicants,
8 Fulwood Place,
High Holborn,
London, WC1V 6HG.
Chartered Patent Agents.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1978.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1505702 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

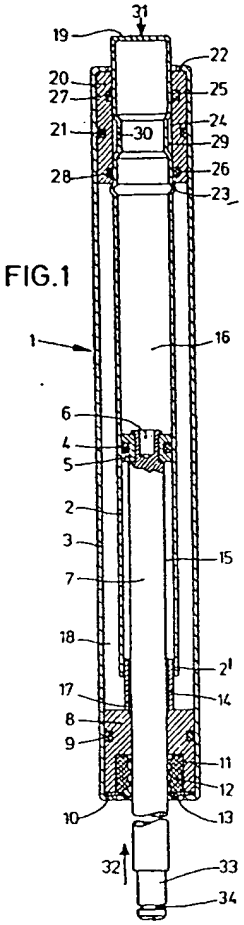

FIG.1

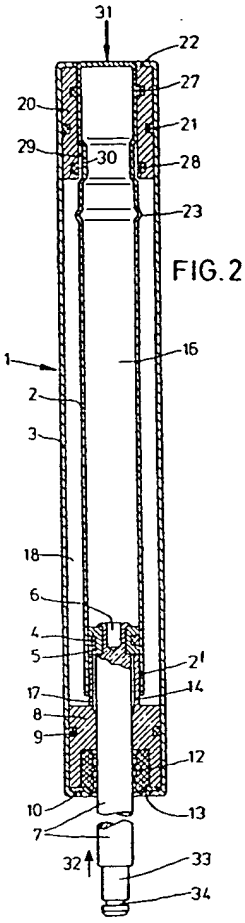

FIG.2